How is global climate change directly affecting the oceans?
The ocean has absorbed over 80% of the heat added to the earth’s system due to climate change, but water temperatures are changing three times slower than terrestrial air temperatures. Significant changes in temperature patterns, however, show the effects of climate change on marine ecosystems. Some effects of increasing temperatures are changes in marine species distributions as well as their timing of reproduction. Additionally, CO₂ uptake is leading to ocean acidification. This causes a decrease in calcification, meaning that certain species are having difficulty forming shells. All in all, the evidence reveals that marine organisms are at least equally likely to respond to climate change as terrestrial species.

How is this study unique?
Most studies generally focus on limited species, regions, or biological responses; in this study, we provide a comprehensive study of the effects of global climate change on marine ecosystems. In order to do so, we synthesized information from 208 studies, creating a data set of 1,735 marine biological responses to anthropogenic climate change. This study includes responses consistent with and contradictory to the predictions of climate change consequences, as well as some studies in which no change was observed.

On a global scale, how did the responses line up with the expectations?
We examined distribution, phenology, abundance, community change, calcification and demography of marine species, taking into account studies from every one of the world’s oceans. We found that 81-83% of the biological responses were consistent with the expectations of global climate change. These results speak to the magnitude of the effects of climate change and its importance in marine ecosystems.

Caveat
Supporting evidence may include biases, but we attempted to mitigate any possible problems by considering groups of data spanning 30 years or more and discounting changes attributed to factors other than climate change. Furthermore, 24% of the species in our data showed no response, which could be due to sub-par data collection techniques and analysis, complex drivers of change, or evolutionary adaptation.

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